I Claim

1. A process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule, comprising:

(a) providing an array having a plurality of electrodes and a plurality of capture molecules at sites corresponding to the electrodes;

(b) non-specifically attaching an oxidation/reduction enzymatic moiety to one or a plurality of target molecules in a sample for analysis to create a prepped target sample;

(c) administering the prepped target sample to the array and allowing for binding of target molecules to capture molecules;

(d) adding a substrate to the array that will create a local voltage signal when catalyzed by the oxidation/reduction enzyme through local generation of electrochemical reagents; and

(e) measuring for the presence or absence of a voltage signal generated locally by electrochemical reagents at each electrode having a capture molecule attached thereto.

2. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 1, wherein the array having a plurality of electrodes and capture molecules corresponding to the electrodes is generated by a technique selected from the group consisting of *in situ* synthesis with electrochemical techniques, spotting the capture molecules, ink-jet printing the capture molecules, and *in situ* synthesis through photolighography techniques.

3. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 2, wherein the array having a plurality of electrodes and capture molecules corresponding to the electrodes is formed by *in situ* synthesis with electrochemical techniques.

4. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 1, wherein the oxidation/reduction enzyme is selected from the group consisting of laccase, horseradish peroxidase, β-galactosidase, glucose oxidase, alkaline phosphatase, dehydrogenases, and combinations thereof.

5. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 1, wherein the oxidation/reduction enzyme is attached to the target molecule(s) through an antibody and anti-idiotype antibody combination or through a biotin and streptavidin (or avidin) binding combination.

6. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 1, wherein the array having a plurality of electrodes further comprises a porous reaction layer covering the electrodes,

wherein the porous reaction layer has a thickness of from about 0.1 microns to about 10 microns and whereby the porous reaction layer functions to block diffusion of oxidation/reduction activity products such that there is little lateral signal being picked up at an adjacent electrode.

7. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 6, wherein the porous reaction layer is made from a polymeric material selected from the group consisting of polyvinyl alcohol, polyvinyl acetate, polyvinyl alcohol, tricellulose acetate, polyurethane, agarose, controlled porosity glass with a PTFE resin, dextran, epoxy-based polymers, and combinations thereof.

8. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 1, wherein the capture molecule is a molecule from the class of molecules selected from the group consisting of oligonucleotides, polypeptides, antibodies, glycosylated polypeptides, polysaccharides, and mixed molecules having monomers from a plurality of the foregoing molecules.

9. The process for reading microarray devices having addressable electrodes to determine binding between a capture probe and a target molecule of claim 1, wherein a target molecule is from a class of molecules selected from the group consisting of DNA, RNA, single-stranded DNA, ribosomal RNA, mitochondrial DNA, cellular receptors, glycosylated membrane-bound proteins, non-glycosylated membrane-bound proteins, polypeptides, glycosylated polypeptides, antibodies, cellular antigenic determinants, organic molecules, metal ions, salt anions and cations, and combinations thereof.

10. A mircoarray device for detecting binding of a target molecule to a capture probe, comprising:

(a) an array having a plurality of electrodes and a plurality of capture molecules at sites corresponding to the electrodes;

(b) an oxidation/reduction enzymatic moiety bound to one or a plurality of target molecules in a sample for analysis, wherein the oxidation/reduction enzymatic moiety bound to the target molecules is incubated with the capture molecules on the array such that binding between capture molecules and target molecules that bind, will occur;

(c) a substrate molecule that will create a local voltage signal when catalyzed by the oxidation/reduction enzyme through local generation of electrochemical reagents; and

(e) a voltage signal measuring device electrically connected to each electrode on the array.

11. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 10 wherein the array having a plurality of electrodes and capture molecules corresponding to the electrodes is generated by a technique selected from the group consisting of

in situ synthesis with electrochemical techniques, spotting the capture molecules, ink-jet printing the capture molecules, and *in situ* synthesis through photolighography techniques.

12. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 11 wherein the array having a plurality of electrodes and capture molecules corresponding to the electrodes is formed by *in situ* synthesis with electrochemical techniques.

13. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 10 wherein the oxidation/reduction enzyme is selected from the group consisting of laccase, horseradish peroxidase, β-galactosidase, glucose oxidase, alkaline phosphatase, dehydrogenases, and combinations thereof.

14. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 10 wherein the oxidation/reduction enzyme is attached to the target molecule(s) through an antibody and anti-idiotype antibody combination or through a biotin and streptavidin (or avidin) binding combination.

15. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 10 wherein the array having a plurality of electrodes further comprises a porous reaction layer covering the electrodes, wherein the porous reaction layer has a thickness of from about 0.1 microns to about 10 microns and whereby the porous reaction layer functions to block diffusion of oxidation/reduction activity products such that there is little lateral signal being picked up at an adjacent electrode.

16. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 15 wherein the porous reaction layer is made from a polymeric material selected from the group consisting of polyvinyl alcohol, polyvinyl acetate, polyvinyl alcohol, tricellulose acetate, polyurethane, agarose, controlled porosity glass with a PTFE resin, dextran, epoxy-based polymers, and combinations thereof.

17. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 10 wherein the capture molecule is a molecule from the class of molecules selected from the group consisting of oligonucleotides, polypeptides, antibodies, glycosylated polypeptides, polysaccharides, and mixed molecules having monomers from a plurality of the foregoing molecules.

18. The mircoarray device for detecting binding of a target molecule to a capture probe of claim 10 wherein a target molecule is from a class of molecules selected from the group consisting of DNA, RNA, single-stranded DNA, ribosomal RNA, mitochondrial DNA, cellular receptors (*i.e.*, glycosylated or non-glycosylated membrane-bound proteins), polypeptides, glycosylated polypeptides, antibodies, cellular antigenic determinants, organic molecules, metal ions, salt anions and cations, and combinations thereof.